REPORT

ON THE

LOCATION OF THE WESTERN PORTION

OF THE

BALTIMORE AND OHIO RAIL-ROAD,

TO A

COMMITTEE OF THE CITY COUNCIL OF WHEELING.

BY

CHARLES ELLET, Jr.

CIVIL ENGINEER.

PHILADELPHIA:
PRINTED BY JOHN C. CLARK, 60 DOCK STREET.
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REPORT

ON THE

LOCATION OF THE WESTERN PORTION

OF THE

BALTIMORE AND OHIO RAIL-ROAD.

Georgetown, D. C.
December 10th, 1849.

To the Rail-road Committee of the City Council of Wheeling:

Gentlemen,—In compliance with the request of your Committee, I have examined the papers placed in my hands, touching the location of the Baltimore and Ohio Rail-road from the mouth of Piles' fork of Buffalo creek to the City of Wheeling.

In presenting the conclusions at which I have arrived from the facts before me, it is proper to observe that I have made no examination of the several lines proposed, with the view to the expression of an opinion upon the conformity of *either* location with the intentions of the law which should control the survey. For the objects contemplated by your resolution, it seemed to be necessary only to examine the law of

Virginia, authorizing the construction of the road, the contract between the Company and your City, which originated in that law, and the estimates of the cost of constructing, maintaining and working the road, upon the several routes which have been surveyed under the directions of the Company.

The Act of March 6, 1847, requires primarily that the road shall be constructed through the territory of Virginia, "so as to pass from a point in the ravine of "Buffalo creek, at or near the mouth of Piles' fork, "to a depôt to be established by said Company on the "northern side of Wheeling creek, in the City of "Wheeling."

Secondly, that the road which shall be constructed between these limits, shall be laid upon that line which shall appear, after full examinations and instrumental surveys of all the practicable routes, "to be the cheapest upon which to construct, maintain and work said "rail-road;" and

Thirdly, that the estimates of comparison "shall be "made on *like principles and plans*, in *like manner*, and "upon *as great* respective amounts of trade and travel "as were adopted and employed in the comparative "estimates of the Company's Chief Engineer, laid before the meeting of the stockholders of the said Company, held in Baltimore on the 12th day of July, "1845."

There are several points in the provisions of this law of great interest to the citizens of Wheeling, and which require to be particularly noted.

The location must be made on that route where the road will be the cheapest to construct, maintain and work, when the cost of constructing, maintaining and working each line, is carefully estimated, according to the principles and plans which are laid down in a certain report; and the estimates are made in *the manner* in which the estimates of that report were made.

The plans and principles which controlled the comparative estimates contained in this report of the Chief Engineer of the Company, have thus been made a fundamental part of the law authorizing them to construct their road through the territory of Virginia.

It is therefore the duty of the engineer, in choosing between the several routes proposed for the road, to consult that report, in order to ascertain what are its "principles and plans," or the objects which its author contemplated, and his "manner" of effecting his purpose.

On referring to the document in question, we find that there are no calculations contained in it, nor any principles whatever, which can serve as the basis of computations for determining the cost of construction, maintenance or working of any rail-road line. There is in fact but one "principle" laid down, and that only as the general object aimed at, and for the attainment of which the comparative estimates presented to the stockholders were intended.

On pages 15 and 16, introductory to these estimates are the following passages—"The object of the Com-"pany since its organization in 1826, having been to "reach the Ohio river at the best point, by the '*shortest and best route,*' and the territory of the State of "Maryland not extending to that river, the Company "was dependent upon Pennsylvania or Virginia." "This avenue (through Pennsylvania) now being "closed for the present, and the Company thrown "back upon Virginia again, the question now is whether the route and terminus offered by the present "law (that of February 19, 1845), fulfils the condition "of the '*shortest and best,*' in a degree sufficient to "induce its adoption, supposing all other obstacles to "be removed. To assist the stockholders in arriving "at a conclusion upon this question, I respectfully "submit the following *statement of facts*, in which a "comparison of some of the main routes from Cumberland to the Ohio is concisely presented."

In compliance with the tenor of these preliminary observations, there is then presented a statement of the lengths of the several routes to the Ohio, and another statement of the probable cost of constructing, and the capital equivalent to the cost of working these routes respectively. But these are mere statements of quantities, and are in no shape deduced, or in any way accounted for, in the report.

In fact, the only "principle" laid down in that document, and the only *principle* which the report recognises as controlling the estimates, is the broad purpose announced and professed to be adhered to—of seeking the "shortest and best route" to the Ohio river. This must be the ruling "plan" also, for there is nothing else in the report to which that word can properly apply, excepting the single passage which states that the estimates contemplated a double track.

The avowed object of these estimates was to exhibit the *shortest* and determine which was the *best route;* and in adopting the plans and principles which controlled the estimate, the Legislature, it would seem, must have intended that the "shortest and best route" should be the route of the road.

It is true that there is an appearance of some inconsistency in requiring that the route should be at the same time both the *shortest* and the *best*, since it might happen that the shortest would not be the best. In this, however, the law only adopts the language of the Company's Chief Engineer, who, in common with many others, seems to have regarded the words "shortest" and "best" in this view, as almost synonymous. It will be seen moreover, as we advance, that the inconsistency of the statute is here only apparent; for the proper location in the present instance, completely fulfils both conditions—the shortest line being also very much the best.

But the law goes further. It provides that the route shall be the shortest (if possible) but certainly the best; and in prescribing the mode of estimating the comparative merits of different routes, it expressly requires that the one selected shall be that which shall appear to be "the cheapest to construct, maintain and work."

In view of all these provisions, I cannot but think that the purpose of the law was to confine the Company to the route which was positively THE BEST, as that was laid down as the controlling principle and indispensable condition in the report of their engineer, of which the "principles" were expressly adopted by statute: that it was intended to combine with this requirement the further condition that the shortness of the line, and hence the value of time, should be fully considered, and that this value should enter into the cost of constructing, maintaining and working the road. In brief, it appears to me that all the requirements of this law can only be properly fulfilled by a location which, after examining *all* the practicable routes between the limits designated, and carefully weighing every element which enters into the determination of the respective merits of the several lines proposed—which takes into account the cost of construction, maintenance and working, the values of grades distances and relative speed, and after reducing all these values to dollars, shall be the very cheapest that can be obtained.

And I am advised by your counsel, that as there is no line of calculation laid down in the report referred to in the law, by which these values may be estimated, it is left for the engineer, whose duty it may become to institute the comparisons, to avail himself of the safest and best data which experience supplies.

But in making the final application of these elements, we are to be further guided by the report of July 12, 1845, and make the comparative estimates "in like manner," as they are presented in that document. But, as already stated, "the manner" in which those estimates were made does not appear in the report itself; but the statements are therein presented in such a form, that we may reasonably conclude that they were obtained by first assuming a certain sum for the cost of original construction on each route, then the annual charges for maintaining and working the several lines discussed, including in these charges the proper value of every item which affects the cost, and then determining the capital which, at lawful interest, will produce these annual charges. The capital apparently thus obtained, is then in the report, added to the cost of construction, and the results show the aggregate cost of constructing, maintaining and working the several lines. The law requires that the route on which this aggregate is the "cheapest," or least, shall be the chosen line.

Finally, the application of these principles, which control the estimate, involves the assumption of a certain amount of trade and travel. The Act requires on this head that the respective amounts of trade and travel, for which the estimates are to be made, shall be "*as great* as were adopted and employed in the comparative estimates" presented in the report of July 12, 1845. The *plans* and *principles,* under the law, are to be precisely like those which were employed in determining the "shortest and best" route; but the trade and travel must be at least "as great," and, if good cause can be shown, they may, apparently be greater.

It will appear, as we progress, that this is a very important point to determine—the amount of trade and travel which may be properly assumed. The greater the business of the road to be accommodated, the greater will be the superiority of the Grave creek over the Fish creek route.

But it is practicable for the engineer to avoid the consequences of any misconstruction of this part of the law, by making two estimates, and assuming, first, the precise quantities which are expressed in the Act as the limit below which the trade and travel shall not be assumed; and then making a further estimate based on the quantities which, in his judgment, and from the facts, may be reasonably anticipatad on the completion of the road to the Ohio.

Your Committee will thus perceive how much the choice of routes from the mouth of Piles' fork to the City of Wheeling might depend on the judicial construction of the Act of March 6, 1847, which is embarrassed by the adoption of the principles of a certain report, in which report there is no distinct principle announced, beyond the mere statement that the great object of research is to obtain the "shortest and best route" to the Ohio river.

In the report and documents submitted to me, it appears that the Chief Engineer of the Company appreciated this difficulty, in attempting to compare the several routes which he had surveyed, in the mode indicated by the law. Instead of making the calculations of the cost of maintenance and working by employing the principles and plans of the report of July 12, 1845, as the Act specifically requires, he has rejected that report altogether, and substituted the principles of a certain other document dated *February* 14, 1838, from which he supposes that the principles of the report adopted by the law were originally derived. But I can find no authority for this substitution of the report of February 14, 1838, in lieu of the one specified in the charter, in any part of the Act which authorizes the Company to construct their road through the territory of Virginia. Indeed, I can find no reference in the report of July 12, 1845, itself, to any previous report, as authority for its facts, principles or figures: and I am advised by the counsel of the City of Wheeling, that it is not permissible to substitute for the principles of the report quoted by the law those of any other document; that the report having been incorporated into the law, must be interpreted from its own language and not by the aid of extraneous testimony.

This being so, the only "principle" that can here guide the engineer, is that which requires him to determine the "*best*" of all the practicable routes by ascertaining their respective costs of construction, maintaining and working, and including in these annual charges every element that affects the question of comparative *cheapness*.

In pursuing this course, I shall not adopt the speculations or theories of any writer, or any document, but shall confine myself strictly to practical results, and especially to the results which have been obtained on the Baltimore and Ohio Rail-road itself. I shall employ no elements that are not fully confirmed by the latest experience of this Company, and few, if any, facts which are not sustained by the published opinions of the present able Chief Engineer of that Company. It shall be the aim also to give such form to the estimates that every reader, without pretensions to scientific or professional attainments, may be able to judge of the soundness of the conclusions.

In order to relieve the subject of all the uncertainty of construction to which the language of the charter may be liable, both as regards the objects to be embraced by the estimate and the amount of trade and travel which shall control the computations, I shall endeavour to determine—

I. Which is the "SHORTEST" "of the feasible or practicable routes;"

II. Which is the cheapest route to construct, maintain and work, with an annual trade of 60,000 tons and 150,000 persons;

III. Which is the cheapest to construct, maintain and work, with such a trade as may be reasonably expected on the completion of the Baltimore and Ohio road to the Ohio river.

IV. Which is positively the "best route" between the points named in the law, in the broadest sense, and under the most comprehensive view that I am able to take of the subject.

OF THE COMPARATIVE LENGTHS AND OTHER PROPERTIES OF THE SEVERAL ROUTES PROPOSED.

After minute survey, the Chief Engineer of the Company, in a report dated February 15, 1849, has presented statements of the lengths, grades and curvatures of three lines of road, extending from the mouth of Piles' fork of Buffalo creek to the City of Wheeling. Taking these several routes in the order in which they are presented in the report, we have for their respective lengths, measured from the point at which they first diverge from their common stem, about three-fourths of a mile west of Long drain—

I. The Grave creek route by Hart's run $41\frac{305}{1000}$ miles;
II. The Grave creek route by Big run $45\frac{890}{1000}$,,
III. The Fish creek route - - $52\frac{270}{1000}$,,

The Grave creek route by Hart's run is $4\frac{585}{1000}$ miles shorter than the route by Big run, and $10\frac{965}{1000}$ miles—or only 62 yards less than 11 miles—shorter than the route by Fish creek.

Of the three routes surveyed, the Grave creek route by Hart's run, therefore, fulfils the condition of "shortest"—one of the great objects sought by the Company since its organization, and one of the cardinal principles recognised in the report of July 12, 1845—in an eminent degree. There is no route terminating at Wheeling, by which the Ohio river can be approached south of Grave creek, that can be compared with it in this important aspect—though there is ground to believe that a shorter line even than this may be found by the valley of Wheeling creek. But as this route has not yet been subjected to the "full examinations and instrumental surveys" contemplated by the law, it is impossible to institute any just comparison of its merits with those of the lines which the Company have caused to be thoroughly examined.

Now, it must be recollected, that the computations which the Act of March 6, 1847, adopted as the model for future estimates, were declared distinctly to be made in order to ascertain "whether the route and terminus offered by the previous Act fulfilled the condition of the 'shortest and best' in a degree sufficient to induce its adoption:" that the Legislature, in that act, decided the question of terminus, by fixing it at the principal city of the commonwealth west of the Alleghany mountains; but ingrafted upon the law the "principles" of the report in all other respects,—which principles prescribe that the route leading to the chosen terminus shall be the "shortest and best."

It is a singular fact that the Company, in attempting to act under this law, have waived this first principle in the most striking manner, and instead of adopting the shortest route to the designated terminus, have probably not surveyed it all; and in choosing between those routes, having a southern bearing, which they did examine, have decided on adopting the very longest.

On observing this conclusion we are naturally led to look for some adequate cause to justify it, in other features of the two lines; for it is not to be denied that there may be advantages possessed by a longer line which would in fact outweigh the value of the increased distance, although the report of the Company's Chief Engineer, which has been sanctioned by the Legislature, seems to assume that "the shortest" must, of necessity, be identical with "the best."

But, on inspecting the elements presented in Tables A 1, and A 3, accompanying and illustrating the comparative estimates in the report of February 15, 1849, we find that the Fish creek line has an aggregate excess of curvature over that of Grave creek, by Hart's run, equal to 683°, or *nearly two full circles;* and that, while the length of the Fish creek line exceeds that of Grave creek by 11 miles, the aggregate length of its curved lines exceeds the total length of curved lines on the Grave creek route by $11\frac{679}{1000}$ miles. We learn from this fact that *the entire excess of distance by the Fish creek route is made up of curves.*

Still, that line, so much the longer and so much the more indirect, is the choice of the Company. We must look then for its merits in other peculiarities which tend to reduce the cost of its construction, or the expense of operation upon it, when completed.

The claims, and the only claims of this route, consist in the greater economy of its construction, according to the estimate of the Company's engineer, and the slighter acclivity of its grades.

The value of these advantages must be considered under the second general division which I have adopted, viz :—

COST OF CONSTRUCTION, MAINTENANCE AND WORKING,

Under an Annual Traffic of 60,000 *Tons of Freight and* 150,000 *Passengers.*

In the report of the chief engineer of the Company, dated February 19, 1849, which has been submitted to me for examination on the part of your city, I find estimates of the cost of construction for the three routes surveyed. But in the following examination I shall take no notice of the Grave creek route by Big run, which I regard as very much inferior to that by Hart's run, and shall confine the comparisons about to be instituted, to the Grave creek route by Hart's run, of which the estimated cost is - - - $2,290,873
And to the Fish creek route, of which
the estimated cost is stated at - - 1,971,638

Showing a difference of - - - $319,235
for the amount by which the estimated cost of constructing $41\frac{305}{1000}$ miles on the Grave creek route, exceeds the cost of $52\frac{27}{100}$ miles on the Fish creek line.

This certainly exhibits a very large balance in favour of the longer line, and in the absence of other information, these facts must be assumed to be correct. Yet it is proper to say to the Committee, that from the language of the engineer's report I infer, that the estimates for the Fish creek route were not made for the precise line which it is proposed ultimately to adopt. The plan seems to contemplate a future change of location, which will increase the cost and reduce the distance. But sufficient facts are not given to enable me to ascertain how much the cost of original construction on that route may have been diminished by this temporary expedient. I am not able to judge, either, how far the adoption of permanent arrangements on one route and temporary devices on the other, as the basis of the calculations, is an infringement of the intentions of the Act which prescribes the mode of making these comparisons.*

I will add, moreover, that my views differ widely from those of the distinguished engineer who conducted this survey, as to the principles which should control the location; and that an examination made upon different principles might show a very different result. If engineers differ in their estimates of the comparative values of given grades and given distances, they must, of necessity, differ also in the amount of labour which should be incurred to reduce a grade or shorten a line. But I have made no such survey, and therefore, in the deductions which follow, I assume that the Grave creek route is the most costly to construct by the above sum of $319,235.

OF THE COST OF MAINTENANCE AND WORKING.

The difference between the costs of transporting a given amount of tonnage over the two lines now to be compared, depends on the values attributable to the steeper grades on the one route, and the greater distance the tonnage must be carried on the other.

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*The precise language of the report, on this subject, will be quoted in a future page.

The Grave creek route is eleven miles shorter, and its course more direct than the Fish creek line; but it overcomes a greater elevation, and its grades are steeper and more difficult to ascend. The problem now before us is, to take proper account of these differences, and endeavour to form a just conception of the respective values of the more difficult gradients of the one line, and of the longer development of the other.

But your Committee will not look for a solution of this question pretending to mathematical precision. There is no rule by which engineers can determine the cost of working a rail-road in anticipation of its construction, with any greater degree of accuracy, than a well informed and observing business man can tell the cost of carting or wagoning produce upon a road which is yet to be made through a new country. It is *experience* that lies at the foundation of his estimate, and the result which he produces merits confidence just in the proportion of the intelligence and good judgment which rule the application of that experience.

In the case before us, we must apply the most authentic results which we can derive from the experience of similar works—taking care in making the application to deal cautiously with the facts obtained from the reports of those companies which keep open construction accounts, or which have been less than five or six years in full operation.

It is impossible to find two roads in which all the conditions and circumstances, affecting the cost of transportation, are precisely alike; and in attempting to employ the actual results of a known work in order to obtain approximate results applicable to one which is not yet in existence, it must be the care of the engineer to look for a case as nearly resembling the one to be investigated, as it is possible to find. In the following comparisons I have chosen the Baltimore and Ohio Rail-road as the work which will more closely compare with its proposed continuation to the Ohio—in all the elements that affect this question—than any other line of which the precise experience is known or attainable.

The cost of transportation upon a rail-road is made up of numerous items, which are classified in the recent reports of the Baltimore and Ohio Company, as follows:—

CLASSIFICATION OF EXPENSES.

I. MOTIVE POWER—Including the cost of repairing locomotive engines and tenders, fuel, oil, cotton waste, and the wages of enginemen and firemen.

II. CAR EXPENSES—Including the cost of repairing cars, grease for cars, and the wages of conductors and brakemen.

III. ROAD EXPENSES—Including the repairs of railway, repairs of bridges, repairs of depôts, repairs of water stations, pumping water, and watching bridges.

IV. GENERAL EXPENSES—Including the pay of agents and clerks, pay of depôt labour, miscellaneous charges, losses by fire, salaries, office rent, legal expenses, taxes, insurance, &c.

Now, it is necessary, before attempting to estimate the comparative costs of transportation, upon two lines differing from each other in grades and distances, to inspect these several items which go to make up the aggregate of expenses, and endeavour to determine on which the charges are proportional to the length of the line, on which they are dependent on the steepness of the grades or on the elevation to be surmounted, and on which they are alike independent of grades, distances and elevation.

A moment's reflection teaches, that the repairs of locomotive engines and tenders, will cost, with the same loads, very nearly in proportion to the distance the engines travel, at the same speed, over the same description of track. This item of a company's expenditure, all other things being equal, must therefore increase just in proportion as the length of the road is increased.

It follows from this, that if we have sufficient data for fixing the cost of repairs per mile run, for each ton and each passenger carried on a known road, we have only to multiply that increment by the number of tons and persons which will constitute the annual trade and travel, and by the distance or length of the projected road, to determine the value of this item.

But, it will be observed, also, that if two routes are presented, on one of which the grades are steeper than on the other, the engines will not be capable of carrying as heavy trains on the steeper road as on the one which has gentler slopes, and that if the trade is sent in large quantities they must make more trips with lighter loads, and consequently run a greater number of miles, to do the same amount of useful work.

It follows, therefore, that the cost of repairing engines is proportional to the length of the road, in the first place, and is affected by the steepness of the grades in the second place.

In the comparison which we are here instituting, however, we are in a great measure relieved of the necessity of calculating the value of the steeper grades of the Grave creek route, since it is proposed by the engineer of the Company to work the more difficult parts of that line by the aid of an assistant engine—so that the through engines can make their regular trips upon the shorter and steeper, as they do upon the longer, route by Fish creek. The maintenance and working of this assistant engine, will thus be made to cover and account for, the whole effect of the steeper grades upon the cost of the motive power.

It is by no means intended however, to admit that in the practical working of the road, and as the tonnage and travel are actually distributed, it will be necessary constantly to employ assistant power upon the Grave creek line, though as the estimates of the Company's engineer have been based upon that supposition, I shall deem it advisable to follow the same course in the first view of this subject.

The fact is, that if the trips are made *in the same time* on both routes, the engines will be able to carry larger loads of freight and passengers on the Grave creek than they can on the Fish creek line, and carry their loads at less cost also, ton for ton and mile for mile. It is only when we assume that they travel at *the same speed*, and estimate the value of the extra time consumed on the longer route, that we can make the allowance for occasional use of assistant power.

The foregoing considerations apply also to the cost of fuel—a part of the expense of motive power—which, after providing for that consumed by the assistant engine, must be nearly proportional to the distance the engines travel at the same speed, and therefore to the lengths of the respective routes. They apply also to the grease consumed by the engine—which is strictly proportional, with the same locomotive, to the number of times the joints are worked, to the number of strokes of the piston, and consequently to the length of the road traversed. When we allow for the oil consumed by the assistant engine on the Grave creek route, we fully account for the effect of the grades of that route upon this division of the cost of motive power.

The same considerations hold when discussing the value of the wages of the enginemen and firemen. They are paid for their time. The time they work depends on the distance they travel, and that distance is the length of the route. Their wages, then, increase in proportion as the length of the road is increased; while the effect of the grades upon this item is fully embraced in the cost of running the assistant engine when it is needed.

In the matter of car expenses, it is too clear to require explanation, that the cost of repairs, grease, and wages, are all strictly proportional, at the same speed, to the lengths of the routes traversed, supposing the lines to be equally direct and equally free from curvature. The same loads of passengers and goods are put in the cars whether they run upon level or upon undulating roads, and, within reasonable limits, the same number of cars is therefore required to do the same duty, whatever be the grades passed over.

The Grave creek route being eleven miles shorter than the Fish creek line, its annual car expenses will be less by the number of tons and passengers carried multiplied into the practical value of these expenses per ton and per passenger per mile, and by eleven miles of distance. Some allowance is also due on this item for the smaller amount of curvature on the Grave creek route.

The repairs of railway are also proportional, under the same speed of transportation, to the length of the line. The cost of renewing the wooden sills that rot is proportional to the number of sills in the road, and this number is, of course, proportional to the distance.

The righting and regulating, sodding, leveling, and ditching, securing rails and chairs and spikes, are all items of which the cost increases as the length of the road increases.

The wear of the iron rails, under the action of a given traffic, is proportional, if the velocity is constant, to the number of rails exposed to the wear, and this number is proportional to the length of the road.

The repairs of depôts are proportional to the number of depôts of the same class. This number is approximately, but by no means strictly, proportional to the length of the road. In the present instance, the longer line by way of Fish creek will involve the necessity of an extra depôt, and all the arrangements incident to the accommodation of the trade, spare power and spare cars of an important station on the river. The charge due to this item will therefore be more than the average due to the distance on that line.

The repairs of water stations is proportional to the number of water stations, and an increase of eleven miles in the length of the road will involve the necessity of an additional station.

The cost of pumping water for a given trade, is nearly proportional to the number of stations at which water is needed, and this again to the number of miles traversed by the engines. Eleven extra miles will render indispensable a new station, and an additional force to man that station.

In the item of *general expenses*, the pay for depôt labour, is nearly proportional, with the same trade, to the length of the road. It cannot be less in the present instance, and under the necessity which clearly exists of having an additional, and very considerable, depôt on the extra space of eleven miles.

The losses by fire, on a given amount of traffic, will be proportional to the time the property is exposed on the journey; and this time is proportional to the length of the road.

Salaries, office rent, legal expenses, taxes, insurance, are all items of expense which increase with the extent of the Company's possessions and business doings, and these increase more nearly, under the same trade, in proportion to the length of the road, than to any other general approximate law.

The repairs of bridges, and the watching of bridges, are exceptions to this rule. These items depend for their value upon the number and character of the bridges.

It will thus be perceived, that the value of almost every item of rail-road expenses increases, with a given amount of traffic, and under a given velocity, just in proportion as the length of the road increases. while the motive power expenses only are increased by an increase of the steepness of the gradients.

These principles being premised, it remains to determine the cost of maintaining and working each of the lines under discussion; and for this practical application, it is necessary to ascertain the precise value of each item of expense per passenger and per ton carried over one mile of road.

I have already stated that in the present question between the Baltimore and Ohio Rail-road Company and your city, the best measure of these expenses that can be applied, is that which results from the past experience of the Baltimore and Ohio road itself. These are beyond all doubt the most apposite and unexceptionable data that can be employed in this case.

The Baltimore and Ohio Rail-road is a work of great length, which has been in activity, in whole or in part, during a space of eighteen years; and has enjoyed the advantage, through the entire period of its history, of unusual talent and experience in every department of its management. It is, moreover, a line which must be admitted to be worked,—as is fully established in several annual reports,—with remarkable skill and economy.

On applying this experience to the determination of the comparative merits of the routes at issue, I shall take the most recent results—those which have been obtained since the extension and equipment of the road to Cumberland, and the reception upon it of the coal and iron of Frostburg in large quantities—those commodities which the official reports of the Company correctly allege can be transported most cheaply.

The effect of taking that experience which exhibits the lowest rate of transportation is to reduce the value of distance, and hence to abate the claims of the Grave creek line; for the higher the expense of carriage, the greater will be the cost of working the eleven miles of extra road on the Fish creek route; and in assuming the lowest experience of the Baltimore and Ohio Company for the scale of charges which shall control the estimate, we take the view most favourable to the decision which the Company has announced.

By turning to Table (K) of the Twenty-second Annual Report of the President and Directors of this Company, we find the result of the operations on their road for the year 1848, exhibited in a very clear and business-like style. In that document the cost of each item of service is distinctly set forth, for each ton and each passenger carried on any part of the road between Baltimore and Cumberland, during that year. The following values of all those objects of expenditure which increase essentially in proportion as the distance increases, are taken from that table.

Values of Railway Expenses deduced from the experience of the Baltimore and Ohio Rail-road in the year 1848.

	Per passenger per mile. Cents.	Per ton per mile. Cents.
MOTIVE POWER.		
Repairs of engines and tenders, -	.090	.171
Fuel, - - - -	.172	.160
Oil, - - - -	.016	.030
Wages of enginemen and firemen,	.069	.130
Cotton waste, - - -	.002	.002
Total for steam-power, -	.350	.493
CAR EXPENSES.		
Repairs of cars, - - -	.185	.256
Oil and tallow, - - -	.010	.014
Wages of conductors and brakemen,	.056	.051
Total car expenses, - -	.251	.321
ROAD EXPENSES.		
Repairs of depôts, - -	.026	.041
Repairs of water stations, -	.005	.008
Pumping water, - - -	.007	.011
Total road expenses, exclusive of repairs of railway, repairs of bridges and watching bridges,	.038	.060
GENERAL EXPENSES.		
Pay of agents and clerks, -	.023	.043
Pay of depôt labour, - -	.017	.034
Miscellaneous, - - -	.012	.023
Losses by fire, - - -	.006	.012
Salaries, office rent, taxes, legal expenses, insurance, &c. -	.026	.049
Total general expenses, -	.084	.161

In applying this table to any other case, it must be borne in mind that these are only the prices which obtain under the velocities of the freight and passenger trains of the road from which they are derived. But the trains upon the Grave creek route can perform their trips at 16 miles an hour, while those on the Fish creek line must make $20\frac{1}{4}$ miles over a road more indirect, to come out even with them. This difference must be somewhere accounted for in the estimates.

There remains yet to be determined, from the same experience, the cost of maintaining and repairing the road, and also that of repairing and watching the bridges.

The repairs of a railway are properly divisible into two classes—those which are dependent on atmospheric and other natural influences, and those which arise from the use of the road.

To keep a railway in perfect repair, and in safe and complete running order, with ever so small a traffic, will require a certain amount of labour. The wood work is liable to decay, the banks to slide, wash and cave in, the track to disturbance from frost, and the ditches to be filled up. In fact, every part of the work needs attention, and occasional renovation, with or without a large traffic to be supported.

But, if a good and substantial track be originally laid down, the *iron itself* constituting that track, will last for a long series of years, unless it be subjected to very heavy service. Practically, the iron does not rust away, but is worn away by the action of the cars and engines.

If, then, we take a road like that of the Baltimore and Ohio Company west of Harper's Ferry, with a good iron rail well supported, and inspect the repair accounts from year to year, we will find the expenditures at first exceedingly light—because the material is all new—but increasing as the road grows older, until about the fifth year, when the renovation of the most exposed portions of the wood work commences, and the expenditures are materially augmented. But still, the iron remains in good condition, and may not begin to fail essentially for many years—as its duration will depend entirely on the use to which it is subjected. Yet, although the time has not arrived for the renewal of the rail, each ton that has passed along the track has caused a certain amount of injury, and the value of that injury will assuredly appear in the accounts of some subsequent year, when the work of renewal will have commenced.

Now, the new track west of Harper's Ferry is in this condition. The iron is materially worn, but has not yet been renewed; and will not need to be extensively changed for a considerable time to come.*

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* See the last Report of the Canal Commissioners of Pennsylvania, just published. The ordinary repairs of the Philadelphia and Columbia road, for the year, amounted to $936 per mile; but the iron rails are reported as "so much worn as to prevent the road being kept in order for the safe and speedy despatch of transportation," and to require almost entire and immediate renewal.

In order, then, to determine the whole cost of keeping that track in permanent repair, we must add to the charges for *ordinary repairs* the value of the injury which the iron itself has sustained, and which will come into some future account. In making an estimate of the value of this injury, I shall be controlled entirely by opinions of the Chief Engineer of the Baltimore and Ohio Rail-road Company, which have been published by the Directors.

In estimating the ordinary repairs of the Baltimore and Ohio road, I take the experience on the continuous single track of 97 miles, constructed in an approved manner, from Harper's Ferry to Cumberland. This track was built after ample experience and extensive and minute investigation. The accounts for keeping it in order are also stated separately in the annual reports, and are freed from the charges for reconstruction, imperfect plate rails and pieces of double track, which complicate the results on the older line east of Harper's Ferry.

The ordinary repairs of this track west of Harper's Ferry, for the year 1848, the sixth year after its opening, amounted to $982 per mile.* (Twenty-second An. Rep. p. 22.)

The cost of this item, under similar circumstances, on a road which the Chief Engineer of the Baltimore and Ohio Company thinks "resembles the Baltimore

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* The average per mile for the ordinary repairs on the whole road was that year $935.

"and Ohio Rail-road more nearly than any other existing line"—that is, the Western Rail-road of Massachusetts—was $1180 per mile of single track. (Report, p. 22.) This difference is attributed in the report, and perhaps justly, to the alleged superiority of the plan by which the Baltimore road west of Harper's Ferry is supported—a plan which, it is said, saves the iron rails from the excessive wear at the joints, to which they are subjected on the Western road. In evidence of the correctness of this opinion, it is stated by the Chief Engineer of the Baltimore Company, that the cost of renewing iron on the Western road, in 1847, the sixth year after its opening, was at the rate of $213 per mile, while on the Baltimore road, under like circumstances, it was *nothing*.

But this is, nevertheless, an item of expenditure which the reports of that Company admit must sooner or later be borne,—for, in the language of their present experienced Chief Engineer, "when iron begins to go, its destruction advances with accelerated speed." (Report, p. 22.)

The estimates which I am now using are all taken from the published statements of the Baltimore and Ohio Rail-road Company for the year 1848. I adhere to the results for that year in every item, because they are the most recent and are presented in the report in great detail. If I were to adopt the report of 1847, the item of ordinary railway repairs would be less than they appear in that of 1848; and if I were to adopt that of 1849 (which I have received since this report was written), they would be greater.*

In adopting the rule of adhering to the report of 1848 in every item, the aggregate results will not differ sensibly from what would be deduced from an average of several years, for the annual tables are all characterized by great uniformity.

The ordinary repairs for each mile of single track west of Harper's Ferry in 1848, amounted, as above stated, to $982 per mile. But the sum which represents the injury sustained by the track, in the depreciation of the iron rails, is not included in this estimate, for the reason that the iron has not yet been changed.

The value of this item of expenses is, however, estimated by the experienced and talented gentlemen who had charge of all the machinery and repairs of that work in 1844, at $\frac{45}{100}$ of a cent per ton per mile on that part of the road east of Harper's Ferry, and at $\frac{25}{100}$ of a cent on the improved track west of that place.

In relation to these estimates, it is stated by the late distinguished President of the Company, in a letter to the House of Delegates (Feb. 15, 1844)—that "these "estimates and the expenses of transportation are in "every instance derived from the *actual experience*, "not only of other companies, but of this Company; "an experience in our operations of many years, and "from their uniformity, and the economy we have been

* Ordinary repairs on the whole line for 1847, amounted to $737 per mile; in 1849, they reached $1090 per mile.

"enabled to introduce, all estimates founded upon "them possess, in all our calculations, the most satis-"factory authority."

An estimate presented on such authority, and so vouched for, needs no confirmation. I adopt the item here as an established element.

The same experience has further shown that the injury done to the Baltimore and Ohio road by the transportation over it of two passengers, is about equal to that produced by one ton of freight. I adopt this measure, also, on the authority of the Company's reports.

But the value of the ordinary repairs obtained from the reports of this Company, apply only to a road with a single track, while the Act of Virginia, under which these estimates are to be made, contemplates a road with two tracks, in conformity with the "plan" of the report of July 12, 1845.

Here, however, I am at a loss for any information obtained directly from the publications of the Baltimore and Ohio Rail-road Company itself, which will enable me to estimate satisfactorily the difference between the cost of maintaining a mile of single and a mile of double track road, from their own experience. It is the first instance in which I have found occasion to go beyond these reports for authority for any fact; and I regret the necessity in this case, as I desire to make the comparison of the merits of the several routes herein discussed upon data that are furnished by that Company, and fully confirmed by the experience of their own able officers. This item will be an exception to the rule.

In the item of wear and tear of road, due to the trade, there will be no appreciable difference in the cost of repairs, whether the tonnage be carried on one or two tracks. If the same trade be distributed over two tracks instead of one, the wear of the first will be obviously diminished just as much as that of the second is increased. The two tracks will last twice as long as the single one, but when worn out it will cost twice as much to renew them.

But in the item of constant expenses—those which are caused by natural influences, and are in a great degree independent of the amount of traffic—it is quite otherwise. If we must support two tracks instead of one, there will be twice the quantity of sills and sub-sills to renew as they rot, twice the number of rails to be kept in place, and twice the amount of righting and adjusting of the displaced material to be accomplished.

Taking an average of the three last years on two roads more similarly situated than any other two within my knowledge in this country—the Boston and Lowell and the Western—the first of which is provided with a double and the second with a single track, I find a difference in the annual expense of "repairing road, maintenance of way, exclusive of wooden truss bridges and renewal of iron,"—according to statements made to the Legislature of Massachusetts by the Directors, under oath,—amounting to $513 per mile per annum.

I shall estimate this item, in round numbers, at $500 per mile.

We have thus for the ordinary repairs of a single track, according to the experience of the Company, $982 per mile per annum; for the repairs which would be incident to the second track, if they had one, $500 per mile per annum; and for the wear of the tracks, by their own estimate, one quarter of a cent per mile, for each ton of freight, and the half of that amount for each passenger carried.

The cost of repairing bridges I can only estimate by taking the statements presented by the Company's engineer in exhibits C 1 and C 3, illustrating his report of February 15, 1849, on the choice of routes to Wheeling.

According to those statements, it will cost to repair the bridges on the Grave creek, or shorter route, $8,271.23 per annum, and on the Fish creek route, $3,427.32 per annum.*

I make no allowance on either route for the item of watching bridges. Grave creek is an insignificant stream, and there would be no propriety in building a bridge over such a rivulet, upon a plan that would make it advisable or necessary to maintain a watch to insure its safety. Fish creek is larger, but the bridges there, also, may be made so as to be secure without the necessity of an expensive guard. I place the two routes on an equality in this respect.

Having obtained the value of all the important elements of the problem before us, excepting that of the assistant power on the shorter route, and the greater velocity required to be maintained on the longer, which will be considered hereafter, we may now proceed to apply the facts to the two lines before us, and ascertain the costs of maintaining and working them respectively.

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* When the route by Fish creek is ultimately changed, more bridges will be required, but the report does not state whether or not any now estimated are then to be dispensed with.

COST OF MAINTAINING AND WORKING THE FISH CREEK ROUTE—$52\frac{27}{100}$ MILES.

Assumed traffic 60,000 *tons and* 150,000 *passengers.*

Motive Power.		
150,000 passengers carried $52\frac{27}{100}$ miles, at	.350	$27,441 75
60,000 tons „ „	.493	15,461 47
Car Expenses.		
150,000 passengers „ „	.251	19,679 65
60,000 tons „ „	.321	10,067 20
Road Expenses.		
150,000 passengers „ „	.038	2,979 39
60,000 tons „ „	.060	1,881 72
General Expenses.		
150,000 passengers „ „	.084	6,586 02
60,000 tons „ „	.161	5,049 28
To which must be added the ordinary repairs of $52\frac{27}{100}$ miles of single track, at $982, - - -		51,329 14
The maintenance of $52\frac{27}{100}$ miles of second track, at $500 per mile, - - - - -		26,135 00
The wear and tear of $52\frac{27}{100}$ miles of iron rails consequent on the passage of 60,000 tons of freight at $\frac{25}{100}$ of a cent per ton per mile (chief engineer's estimate), - - - - -		7,840 50
The wear and tear of $52\frac{27}{100}$ miles of iron rails consequent on the passage of 150,000 passengers, estimating 2 persons and baggage as equivalent in wear and tear to one ton of freight (chief engineer's estimate), - - - - -		9,800 62
The cost of maintaining bridges (engineer's estimate),*		3,427 32
Total, exclusive of items to be hereafter considered,		$187,679 06

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* More bridges are contemplated, ultimately, on this route.

COST OF MAINTAINING AND WORKING THE GRAVE CREEK LINE—$41\frac{305}{1000}$ MILES.

Assumed traffic 60,000 *tons and* 150,000 *passengers per annum.*

MOTIVE POWER.			
150,000 passengers carried $41\frac{305}{1000}$ miles, at	.350		$21,685 12
60,000 tons " "	.493		12,218 02
CAR EXPENSES.			
150,000 passengers " "	.251		15,551 31
60,000 " " "	.321		7,955 34
ROAD EXPENSES (exclusive of track and bridges).			
150,000 passengers " "	.038		2,354 38
60,000 tons " "	.060		1,486 98
GENERAL EXPENSES.			
150,000 passengers " "	.084		5,204 43
60,000 tons " "	.161		3,990 06
To which must be added, the ordinary repairs of $41\frac{305}{1000}$ miles of single track, at $982, - - -			40,561 51
The maintenance of $41\frac{305}{1000}$ miles of second track, at $500 per mile, - - - - -			20,652 50
The wear and tear of $41\frac{305}{1000}$ miles of track consequent on the transit of 60,000 tons of freight at $\frac{25}{100}$ of a cent per ton per mile (chief engineer's estimate),			6,195 75
The wear and tear of $41\frac{305}{1000}$ miles of track consequent on the transit of 150,000 passengers, estimating 2 passengers and their baggage as equivalent in wear and tear to one ton of freight (engineer's estimate).			7,644 70
The cost of maintaining the bridges on this line (chief engineer's estimate), - - - -			8,271 23
ASSISTANT POWER.			
To obtain the value of the assistant power I shall at first adopt the estimate of the Company's engineer, and strike the balance upon the assumption that it is properly obtained in his report, and afterward correct the result so as to adapt it to the actual state of trade and the true conditions of the problem.			
The value of the assistant power is set down in exhibit D 1, (engineer's report,) as follows:—			
Passenger engine, working 365 days, at $6.44, - - - -		$2,350 60	
Freight engine, working 312 days, at $6.06, - - - -		1,891 00	
			4,241 60
Maintaining and working the Grave creek line,			$158,012 93

We now have all the material for comparing the respective costs of constructing, maintaining and working these two lines, neglecting the value of time and assuming equal speed on both routes, but following, in other respects, the mode indicated in the law of March 6, 1847.

FISH CREEK LINE.

Cost of construction, by estimate of engineer,	$1,971,638	
Annual cost of maintaining and working this line, $187,679.06—capital equivalent,	3,127,984	
Capital equivalent to the cost of construction, maintenance and working, -		$5,099,622

GRAVE CREEK LINE.

Cost of construction, by estimate of engineer,	$2,290,873	
Annual cost of maintaining and working this line, $158,012.93—capital equivalent,	2,633,549	
Capital equivalent to the cost of construction, maintenance and working, -		4,924,422
Difference in favour of the Grave creek route,		$175,200

In the investigation which leads to this conclusion the transportation is supposed to be effected at the same speed—the speed adopted on the Baltimore and Ohio road—*on both lines.* But to put the two routes fairly on an equality, they must, of course, be traversed in the same *time*, a condition which would greatly increase the cost of working the Fish creek or longer route, and swell also the sum which now stands in favour of its competitor. But to avoid the complication incident to this method, I propose to account for this difference by considering that the same speed is maintained on both lines, and then estimating, as a separate item, the value of the time which is lost by the longer route.

REMARKS UPON THIS RESULT.

It is to be observed that in the foregoing comparisons, I have in all cases made those assumptions, in the construction of the Act of Virginia, of which the effects are most disadvantageous to the Grave creek line. I have assumed the smallest amount of trade which the law will admit, so as to render the result showing the measure of the superiority of the northern route, as far as it is dependent on the amount of transportation, a minimum. In addition, I have taken the results of experience on the Baltimore and Ohio road, obtained from a heavy business, and applied them, without change, to a smaller trade; and I have taken results derived in a very large degree from the transportation of coal, which the reports of the Company admit may be far more cheaply conveyed by rail-road than miscellaneous merchandise, and have applied these results also, without change, in the comparison. I have left out of view the additional capital which must be invested in machinery to work the longer line; and that which will be required to erect a depôt and water station to accommodate that line; and I have taken no notice of the greater destruction of the tracks, engines and cars consequent upon the indirectness and greater curvature of the same route, and the greater speed with which the trains must there be run to accomplish the trips in the same time as on the Grave creek route.

All these items, when properly estimated, go to swell the balance found above, from the facts already employed, for the superiority of the Grave creek over the Fish creek line. But before attempting to estimate the value of these additional considerations, it is important to compare the result already obtained with the conclusions at which the Chief Engineer of the Company has arrived, on the same question, in the report and documents which you have submitted to me.

It will be recollected by your Committee, that the report of the Chief Engineer of the Company exhibits a balance of $297,612, for the estimated value of the superiority of the Fish creek line over that of Grave creek by Hart's run; while I have already obtained, under the most adverse suppositions, a balance of $175,200 in favour of the Grave creek line over that by way of Fish creek. It will also be remembered that in obtaining this result, besides overlooking all the above items of expenditure, I have taken the Chief Engineer's estimate of the cost of construction on both routes, of the cost of assistant power for working the steeper grades of the Grave creek line, of the cost of repairing bridges, of the expense of renewing iron; and, moreover, have in every instance but one, and that a quite unimportant item, employed the experience obtained on the Baltimore and Ohio road itself, and applied it faithfully according to that Company's established classification, and the reductions presented in the tables which illustrate their own reports.

And it must further be observed that I have taken no notice of the fact that the engineer's estimates for a considerable portion of the Fish creek route, are made on a line which is not regarded as strictly permanent, but to be superseded by a more costly work after some indefinite period; and that the estimate for the depôt buildings at the mouth of Fisk creek, which the Company's engineer has presented, contemplates "such "cheap structures only as would be indispensable upon "the first opening of the road, and does not include the "extensive station-houses and work shops which will "grow up," when, perhaps, by the influence of the Company, that point shall have been made the substantial terminus of the road on the Ohio.

Under such circumstances the wide difference in the two results is calculated to excite surprise and elicit scrutiny. And I consider it expedient to investigate the cause of this remarkable discrepancy, before I attempt to correct my own result, which is obtained in so great a degree from data furnished by the reports of the Company and their responsible officers.

It would be very difficult and laborious to explain the cause of this entire difference, item by item; and such an investigation is not at all necessary here. I shall confine myself therefore to a few of the leading points, and endeavour to ascertain from what causes the estimates, as far as we have yet gone, have deviated so widely in their results.

The law of Virginia, under which these comparisons are made, requires, as already shown, that the "plans and principles" employed by the Chief Engineer of the Company in a report to the stockholders, dated July 12, 1845, should control the present estimates. But, on inspecting this report, prescribed by law as our model, so far as the controlling plans and principles are concerned, we find that it only discusses:

I. Certain restrictions imposed on the Company by a law of Virginia passed February 19, 1845, in which there appears to be nothing applicable to the present question.

II. The relative advantages of the several proposed *termini* on the Ohio, a subject placed out of the pale of this inquiry, by the present law, which itself establishes the terminus.

III. The relative merits of the routes by which the several termini were to be approached; and it is only in reference to this part that the principles and plans of the report are to be consulted for the present purpose.

I have already stated that no "plan" is presented in that report except that the road is assumed to be made with a double track. And there is no "principle" whatever announced, and we are left to deduce both principles and plans from a certain statement of facts;

and seem to be restricted, in the consideration of these facts, to their bearing upon the single question of comparative "cheapness."

The report compares several routes with each other. First, as to "length;" secondly, as to the cost of "construction;" and thirdly, as to the cost of "working," which is capitalized.

The principles, rules or modes of determining the cost of construction, or that of maintaining and working the road, are not given. Results only are stated, but the data, from which they were obtained, are all wanting.

The report assumes, as the basis of its estimates of the cost of working, a traffic of 150,000 passengers and 60,000 tons of freight: and it states, and repeats, that "the object of the Company since its organization in "1826, had been to reach the Ohio river at the best "point by the shortest and best route;" and in presenting the comparative statements, or gross estimates, it is expressly declared that they are offered for the purpose of ascertaining "whether the route and ter-"minus offered by the present law, fulfils the condition "of the 'shortest and best' in a degree sufficient to "induce its adoption."

From this abstract it would appear that the only principles and plans by which we must be guided, are, that the road shall be assumed to have a double track; that the cost of constructing, maintaining, and working it must be estimated by the best light which experience furnishes; and that the annual expense of maintaining and working must then be capitalized.

No distinct mode of calculation being laid down in the report of July 12, 1845, there is nothing left for the engineer but to be governed by the experience of existing roads. This I have attempted to do in availing myself of the latest and best data furnished by the Baltimore and Ohio road itself.

Here lies the explanation of a part of the wide difference existing between my results and those of the Chief Engineer of the Company; who, instead of taking the operations on his own work, or any other well authenticated experience as his guide, where the report of July 12, 1845, failed to furnish a guide, has followed the rules laid down in a certain report written eleven years ago, and which have here no practical value.

This is explained in his own words as follows:—

"I will here take occasion to say that in the com-
"parison of the cost of both maintenance and working,
"the '*principles* and *plans*' of the report of *February*
"14, 1838, have been used with the modifications pro-
"per to the change of times and places—as in so doing
"the spirit and intention of the law is carried into
"effect more fully than by the application of the merely
"approximate methods of the report of July 12, 1845,
"which were however founded upon the more exact
"modes of comparison of the previous report, but ap-
"plied only in the way of a general average of results
"upon many different lines, derived therefrom."

Now, I do not understand the Act to authorize any such substitution of the report of 1838 for that of 1845, and I am advised by your counsel that the mere opinion of an engineer that the principles laid down in the latter report were derived from one more accurate and of an earlier date, is no justification of this substitution: that the report of July 12, 1845, must be interpreted from its own language, aided by the words of the law: and that if the principles which it contains are not sufficient to guide the estimate, the deficiencies must be supplied by experience of the most approved and reliable character.

The principles developed in the report of February 14, 1838, I can only gather from the application that is now made of them in the papers submitted to me. I have no copy of the report. In that application it is assumed that we are to treat the several lines to be compared, as imaginary roads, on which all the year's business is divided with perfect uniformity: that the whole traffic of the Baltimore and Ohio Rail-road, when finished to the Ohio river, is to be accommodated by *one* freight train and *one* passenger train, daily, in each direction; that these trains are to carry precisely the same number of tons and the same number of passengers every trip, at all seasons of the year, in every condition of the road, of the trade and of the weather.

This remarkable assumption is made the basis of all the computations offered in the comparative estimates; which, throughout, suppose that every freight train conveys 96 tons of goods, and every passenger train just 205 persons. There is, however, no *law* prescribing this unreasonable and impracticable state of trade and travel, and we have here precisely one of those cases in which we must look to experience to supply the facts and aid the judgment. The experience of the Baltimore and Ohio Rail-road will furnish a fair test of the correctness of this assumption.

That Company possess engines (see 18th An. Rep. p. 13,) capable of hauling 1100 tons on a level road, and 170 tons on grades of 82½ feet per mile,—steeper than any that are to be found on either the Fish creek or Grave creek route,—and a second class of engines, capable of hauling 700 tons on a level road, and 110 tons on grades steeper than are to be found on either of the routes under consideration. Yet, with an abundant supply of such freight engines as these, and a through trade more than twice as great as is specified in the law, from which to fill the cars, the average load in the freight trains of this work for the year 1848, was just 39 tons. But in the year 1845, when the trade was about 63,000 through tons, the average load of the engines was but 29⅕ tons. Thus, with a full supply of locomotives capable of carrying from 600 tons to 1100 tons upon a level road,—and, with the aid of an assistant engine at Parr's ridge, more than 100 tons on all parts of their line,—the Baltimore and Ohio Company, while conveying a trade of 60,000 through tons per annum, never could obtain average loads of 30 tons in their freight trains.*

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* The average loads in the trains when the total trade was from 50,000 to 60,000 tons per annum, was but about 22 tons.

The reason of this is as obvious as the fact is universal upon the rail-roads of this country. The Company are compelled to carry the trade as they can get it. At certain seasons of the year merchandise is sent briskly to the west, and the trade from the west is slack. At other seasons, the west sends off its surplus, and the demand for eastern goods temporarily ceases. On one day it rains or snows, and people are unwilling to expose their property, or labourers are unwilling to handle it; sometimes the markets are dull, and sometimes the crops are not ready for shipment.

The causes are infinite, and the effect is universal. But the Company must keep up its power, and send forward its engines—sometimes with full loads, but often with empty cars, and sometimes with none at all.

In short, the Company cannot control the shipments, but must conform to the usages and the necessities of the country; and though they have ample power to carry a daily train of 96 tons—the Chief Engineer's estimate—they are compelled to send, on an average, more than *three daily trains* properly to accommodate the business of their line; which might, under an equal distribution of tonnage, be almost as easily performed by one.

Is it competent, then, for the engineer to imagine the beau ideal of a perfect system of transportation—as though the crops were grown expressly for the convenience and greatest possible profit of the Company, —or is it his duty to take the facts as they are, the trade, as experience has shown it to be? I can have no doubt myself that, to conform to the reasonable intentions of the law, we must, in this matter, take the results of common experience, and not the theories of a report unknown to the law.

The same course was pursued by the Chief Engineer of the Company in estimating the cost of conveying passengers. The calculation assumes that the trains are filled once every day with just 205 persons. But the experience of the Baltimore and Ohio road for the last year shows that, taking the average of the running of all the passenger engines, the year through, the load is but 50 passengers to each train, or less than one-fourth the number assumed in the computation.

Now, we will note the effect of this on the comparative estimates.

By assuming that each freight train carries more than three times as many tons of goods as it can get, in the actual state of society, and with the actual distribution of traffic, and each passenger train more than four times as many passengers as can be got to fill it, instead of calculating the cost of running more than *seven trains a day*, all told, over the 11 miles of extra distance on the Fish creek route, it is only necessary to provide for *two such trains;* and there thus results an apparent and fallacious saving of about five-sevenths of the whole increase of cost due to the transportation.

While the effect of these suppositions is to diminish the cost of working the longer line by way of Fish creek, they operate in precisely the converse way upon the shorter route by Grave creek. For, by assuming the least possible number of trains, and the greatest possible loads, to make out the annual tonnage, we involve in the same assumption, the constant necessity of assistant power to help the heavy trains over the steeper grades of that line. Regular trains containing 96 tons of freight and 205 passengers each, may require assistant power twice every day; but average trains of 30 tons and 50 passengers—such as are actually run on the Baltimore and Ohio and other similar roads—will pass over those grades without any aid whatever. Indeed, such engines as the Baltimore and Ohio Company have in constant use, may surmount those grades at 10 or 12 miles an hour without any assistance, and with trains of more than double this average weight.

Still, there will of necessity be occasional need of assistant power, and I shall therefore, in correcting the result already obtained, deduct from the allowance for that item but one-half the expense at which it is estimated by the Company's engineer.

The next item to which I will call your attention in the estimate which has decided in favour of a route 11 miles out of the way, and which threatens the business prosperity and importance of your city, is equally remarkable.

The report of the engineer on the comparative cost of working the two routes under consideration, estimates the value of motive power, wear of cars, interest on a spare engine, repairs of bridges, repairs of track and superintendence of railway, specifically, and then sums up under the head of "general expenses," every other charge incident to the expense of maintaining and working the road.

The items of expenditure thus embraced in one body, are the following:

Repairs of depôts; repairs of water stations; pumping water; pay of agents and clerks; pay of depôt labour; losses by fire; miscellaneous items; salaries; office rent; legal expenses; taxes; insurance, &c.

These items are estimated in the report at just thirty-four dollars and twenty cents *a day*, for all sorts of routes, without any regard to their respective lengths.

The assumption of the estimate is precisely this—that the charges for repairing depôts and water stations are the same on all lines without any reference to their lengths, and that the keeping up of an additional depôt and an additional station on the Fish creek line, will involve no additional charge; that the cost of pumping water will not be increased by having an extra water station and an extra force to work it; that the pay of agents, clerks, and for depôt labour, will not be affected by the provision of such agents and labour at the additional depôt required by the eleven miles of additional route; that the losses by fire at that station, along that space of eleven miles, and in the cars which pass over that space, is nothing; and that office rent, taxes, insurance, legal expenses, salaries and miscellaneous charges of all sorts, disappear upon that portion of the road. By such unwarrantable suppositions, all these causes of expenditure are entirely sunk in the computation of the cost of maintaining the eleven miles which are added to the length of the line, that the trains may be sent round by the mouth of Fish creek.

In the item of repairing the road, this extra space is treated in much the same way, and it is assumed that although in 1848, it required $982 per mile to keep the *single track* west of Harper's Ferry in repair, besides the unliquidated cost of renewing the iron, yet the *double track*, on the space in question, can be kept in repair for less than $700 per mile.*

There is another important oversight in the comparative estimates of the Chief Engineer of the Company, which also bears adversely against your interests, but which has not yet been corrected in my own calculations. In all the computations the same scale of prices is used for both lines, as though the difference in the necessary *speed* of the trains upon the two routes, involved no difference in the running expenses and cost of road repairs.

No value is attributed to TIME to compensate for this neglect; and the trains are therefore supposed to run through their respective routes in the same number of hours. But to accomplish this, the Fish creek trains must take smaller loads, and run more than thirty per cent. faster than those on the Grave creek route, thereby consuming more fuel, and incurring greater damage, from wear and tear and accidents, in effecting a given amount of useful labour.

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* The repairs of railway for the whole line of the Baltimore and Ohio road, of which a very small portion has two tracks, amounted in 1849, to $1090 per mile. But this is exclusive of the cost of reconstruction.

No notice is taken of this disadvantage in the comparative estimates, though it is an item of sufficient importance, of itself, to turn the scale in favour of the shorter line. This point will call for further investigation as we proceed.

By this course of computation, in which full *five-sevenths* of the cost of running the trains over the eleven miles of extra space on the Fish creek line, is sunk; the whole of the general and miscellaneous charges for that distance are overlooked; nearly two-thirds of the cost of maintaining the track is buried; and the value of time and effect of speed are passed over in silence, the apparent cost of working that line is reduced to an exceedingly small figure; while, on the other hand, by over-loading all the trains, the cost of ascending the steeper grades of the Grave creek line is proportionably swollen.

Of course, I cannot approve of an estimate which deals with the vital interests of your city in this manner, and it is my duty to assure you that a decision which rests upon this foundation, in my opinion cannot be sustained.

I pass now to the estimation of some of the indefinite quantities which affect the result of my estimate of the cost of working these two routes.

OF THE INDETERMINATE ELEMENTS.

I designate as indeterminate elements certain items which cannot be estimated with satisfactory precision, but which it is nevertheless proper to consider, and deal with under the best light we have. I refer here to such quantities as the value of the excess of curvature on the Fish creek line; the effect of applying the elements of cost obtained under a large trade, to a work having a smaller trade; the effect of applying the experience obtained with a coal tonnage, to a miscellaneous traffic; the abatement of the estimated cost of assistant power in consideration of the reduction of the number of trains requiring the aid of such power; and the value of the water station, depôt, engine house, &c., which will be required at the mouth of Fish creek, and which do not appear in the estimated cost of construction for that route.

The effect of assuming the elements obtained under the large trade of 1848, can be corrected for tonnage by that of 1845, when the trade was about 63,000 tons; the value of this correction, for eleven miles of distance, will be on 60,000 tons, approximately, - - - - - -	$1821 60
The effect of the coal tonnage, in reducing the cost, can be computed on the authority of the Chief Engineer of the Company, from his report, dated February 13, 1844, by deducting the value of the transportation there exhibited from the cost of conveying miscellaneous tonnage, shown above, and applying the difference to the amount of coal carried in 1848, approximately, - - - - - -	1300 00
Carried forward,	$3121 60

Brought forward,	$3121 60
The absolute value of the assistant power which may be required on the Grave creek line, is exceedingly difficult to estimate. The average trains would not contain over thirty tons of freight, and very few of either the freight or passenger trains, would really require aid. The assistant power would, in reality, be nothing more than a spare engine engaged in the service of the road, but occasionally applied to aid a heavy train. I will, nevertheless, deduct but one-half of the whole cost at which this power is estimated by the Chief Engineer, when assuming that it would be required for every train, which gives - - - -	2120 00
The depôt and general station at the mouth of Fish creek, are not embraced in the estimated cost of construction of that route. This will necessarily be a considerable establishment, and cannot be supposed to cost less than the structures now building at Martinsville. These will have cost, when adapted to the "immediate wants" at that point, $47,000 (see last report), interest, - - - -	2820 00
	$8061 60
The capital equivalent to this sum, is $134,360, which must be added to the value of the superiority above obtained for the Grave creek over the Fish creek line. That value was - - - - - - - - - -	$175,200
Adding for the above indefinite quantities, - -	134,360
We obtain the sum of - - - - - -	$309,560

As the best estimate I am able to make from the facts before me, and exclusive of the cost of maintaining the higher speed required on the Fish creek line, of the value of saving the eleven miles of unnecessary space, under a trade of 60,000 tons and 150,000 passengers per annum. The sum of $134,360 last deduced, must be regarded as an approximation, obtained from data which are imperfect and not to be as strictly relied on, as those which have controlled the previous examination.

Before passing to the next division of this subject, it is proper to call your attention to the fact, that the whole sum at which the Chief Engineer of the Company now estimates the cost of maintaining and working the Fish Creek line, with this same trade of 60,000 tons and 150,000 passengers, is but $1524 per mile.

In the report addressed by that officer to the President of the Company, dated June 26, 1847, shortly after the passage of the law under which the Company are constructing their work through Virginia, he described minutely the mode of calculation by which, according to his recollection, the estimates of July 12, 1845, were framed. The application of this method, to the same route, as surveyed, would make the cost of maintaining and working it, $2213 per mile—or nearly $700 a mile more than is obtained by the process now adopted.

It is proper also to state, that, although the Chief Engineer of the Company reports that, in preparing the comparative estimates, he has dropped the method of calculation employed in the report of July 12, 1845, and described in that of June 26, 1847, and gone back to what he deems the more accurate and precise modes used in a report dated February 14, 1838,—on referring to the report of 1838 (obtained since this paper was prepared for your examination), I find that the principles there laid down are, in fact, very different, in most essential features, from those which have controlled the comparative estimates condemning the route upon which the prosperity of your city depends.

In the report of February 14, 1838, *two* daily passenger trains and *two* daily freight trains, are assumed to pass over the road for the conveyance of the amount of travel and tonnage designated in the law—an hypothesis which relieves the Grave creek route of all charge for assistant power, while it almost doubles the charge of working the excess of distance on the Fish creek line.

The final report on the comparative values of the several routes, assumes trains *twice as large* as those which form the basis of the estimates of 1838; while the assumptions of 1838, compared with the results of actual experience, are twice as great as the *fact*.

The Company have, throughout, adhered tenaciously to the route touching the Ohio river 23 miles below you, without regard to cost or distance, but there is great inconsistency in the arguments by which the choice has at different times been sustained.

OF THE AMOUNT OF TRADE AND TRAVEL WHICH MUST CONTROL THE ESTIMATES.

I must again ask the attention of your Committee to those words in the first section of the Act of March 6, 1847, which require that we shall assume "*like* plans "and principles, and make the estimate in *like* manner, "and upon *as great* respective amounts of trade and "travel," as were adopted in the report quoted in the law.

In the opinion of your counsel the true construction of this language is, that the amounts of trade and travel which are to control the estimates shall be *at least* as great as those assumed by the engineer of the Company in the estimates of July 12, 1845; it being the intention of the law merely to fix a *minimum* below which the trade should not be assumed in drawing the comparisons; but that, while requiring that the trade should certainly be "as great" as 60,000 tons and 150,000 passengers, it was never intended, if good reason should exist for supposing that the business would be much greater than this minimum limit, to forbid the adoption of that greater and more probable amount. The direct consequence of such a restriction would be to encourage the location of a road destined for a great trade with a view to the accommodation of a small trade, which would seriously prejudice the future profits of the Company, as well as the business of the community. Such a provision would, in fact, be incompatible with any reasonable view of the public interest; and as it cannot be supposed that the object of the law was to injure and embarrass both the public and the Company, we are compelled to conclude that the construction given to this language by your counsel—"at least as great"—is the reasonable and true one.

But I have made my estimates so as to conform either to that construction of the law which would absolutely limit the trade to 60,000 tons of freight and 150,000 passengers, or to that which leaves the amount of trade (like the other elements) to be estimated on the best attainable data, provided the quantities assumed be not less than those employed in the report of July 12, 1845.

I am not in possession of the estimated amount of traffic which served as the basis of the estimated revenue of the Baltimore and Ohio Rail-road; when it shall be completed to the Ohio river, which was recently submitted by the President to the Directors of that Company, on the authority of their distinguished Chief Engineer. I am therefore unable to obtain direct and precise assistance, from the published views of the Board, on this head.

Nevertheless, the officers of the Company, with habitual moderation in estimating their profits, have furnished us some general guides to the object of the present inquiry.

It will be recollected that the total receipts of the Company, in 1848, from the transportation of passengers, freight and the mails, amounted to $1,213,664. But it is stated in the report of the President (November 14, 1849), that "the Chief Engineer estimates *the increase of revenue at the Ohio river*, at $2,700,000, *of which at least one-half*, or $1,350,000, *would be net.*"

If the 211½ miles from Cumberland to Wheeling, carry just as many passengers and as much freight, of its own, and produce just as much revenue, as the 179 miles from Cumberland to Baltimore, or $1,213,664, then to make up the $2,700,000 of additional revenue, there will be required an increase of through trade and travel, over both divisions of the line, sufficient to produce the sum of $1,486,336.

If we now suppose this revenue, from the additional through traffic, to be obtained equally from freight and passengers, we have only to divide the one-half of it by double the Chief Engineer's estimate of the cost of conveying tonnage, and the other half by double his estimate of the cost of conveying passengers, to obtain the estimated increase of freight and passengers.

The latest estimate of the expenses of working a rail-road line, by the Chief Engineer of the Company, is to be found in considerable detail, in documents D 1, D 2, D 3, C 1, C 2, C 3, accompanying his report on the choice of routes to Wheeling.

By dividing the estimated cost of repairing the road, between freight and passengers, in the mode adopted by the Company in their annual reports, and adding the cost of maintenance to the estimated expenses of running the passenger trains, we find that it costs $43,301 to maintain the line and convey 150,000 passengers over $52\frac{27}{100}$ miles of road on the Fish creek route.

From these data we obtain for the number of through passengers necessary to produce the estimated revenue, by making the charge for fare double the estimated cost of transportation, in round numbers, 173,000 persons.

Operating in the same way with the tonnage trains we will produce for the estimated through tonnage requisite to produce half the estimated through revenue, about 82,000 tons.

These quantities are to be added to the way trade, which amounted, in the aggregate, to 161,000 passengers and 271,000 tons of freight, in the year 1848. This would make a total upon both divisions of the line—of through and way traffic together—amounting to 334,000 passengers and 353,000 tons.

I do not intend to employ these data, for although I am by no means satisfied that the numbers are too high, I object to the estimated cost of transportation on the Fish creek line, from which they result.*

Still, I concur fully in the opinion which is eloquently expressed in the recent admirable report of the President of the Company addressed to the Directors—" that there is a point, conceded it is believed " by the most skeptical, where the revenue of the road " cannot be interfered with—where its destiny will be " forever established—and *where the only question that* " *is likely to arise will be as to the ability of the Company to supply the power to accommodate the trade* " *and travel.* That point, gentlemen, is the Ohio " river." (President's Report, November 14, 1849.) But no one, I presume will contend, that there will be any difficulty in supplying power enough to carry four or five hundred thousand tons and as many passengers.

There is another important fact bearing on this question. The law requires that the estimates shall be based upon the supposition of a double track; from which it may be reasonably inferred that the Legislature contemplated a traffic which would justify the construction of a second track. But the Company transported in 1849, no less than 165,000 passengers and 351,655 tons, on a single track, and that single track was by no means taxed to an extent approaching the limit of its capacity. And here again we find that the most recent opinions of the Company confirm the inference which we are compelled to draw from the language of the Act. In this report of the President, published by order of the Directors, it is stated, that "the Baltimore and Ohio Rail-road was originally chartered with a view to the trade of the Ohio river, *without any reference to those more extended railroad connexions now in progress of formation.*" . . . . . "It may be safely assumed that the resources of the Ohio river alone, for which there can be no competition, *will require more accommodation than this road, when finished, will be able to extend without the aid of a double track.*"

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* If the computations had been based on the estimated cost of working the Grave creek line the results would have been not materially different, though less.

We thus have, in addition to the cautious estimates of the engineer, and the inference drawn from the law, the unanimous opinions of the President and Directors, that when the road reaches the Ohio, the trade of that river alone, without counting on any contributions from beyond it, will be sufficient to require a second track, and that the total trade, in view of those connexions, will be so great as to render the Company's ability to supply adequate power to convey it, a question of serious doubt.

But experience shows that it is perfectly practicable to carry more than a million of tons and a million of passengers, per annum, on a double track rail-road. Your Committee will thus perceive what are the present expectations of the responsible officers of the Company on this important question.

I believe that these anticipations are founded on facts, and will be fully, and I trust speedily, realized. When their great road has surmounted the Alleghany and opened upon the valley of the Ohio, and received its share of the traffic borne on that stream, and formed its western connexions with the lines which will then radiate from Wheeling through Ohio and Indiana, pointing to the Lakes, Cincinnati and St. Louis—and beyond—all their hopes, and more, I truly believe, will be realized.

I shall offer no conjectures as to what will be the absolute amount of this future trade and travel: but I will present here a statement of the tonnage which is now carried on some of the principal railways that spread out fan-like from Boston, that you may judge what ought to be expected on a single line entering the city of Baltimore from the valley of the Mississippi.

TONNAGE OF NEW ENGLAND FREIGHT ROADS—1848.

Boston and Lowell road	carried	-	304,270	tons.
Boston and Worcester	,,	-	273,146	,,
Fitchburg Rail-road	,,	-	266,868	,,
Western Rail-road	,,	-	265,542	,,
Total, - - - -			1,109,826	
Average tonnage of these four roads,			277,456	tons.

This is the total tonnage. The average through freight, for these four roads, was, in round numbers, 220,000 tons per annum.

PASSENGERS CARRIED ON NEW ENGLAND ROADS—1848.

Boston and Lowell road,	-	525,764	persons.
Boston and Worcester road,	-	807,143	,,
Fitchburg Rail-road, -	-	745,825	,,
Western Rail-road, -	-	405,614	,,
Eastern Rail-road, -	-	1,021,169	,,
Boston and Maine, -	-	1,057,569	,,
Boston and Providence, -	-	569,127	,,
Total for these roads,	-	5,132,211	
Average number, -	-	733,173	persons.

The through travel upon these roads is much less, averaging but little over 280,000 persons annually on each line.

I do not mean to draw any conclusions, in this place, from the great railways of this country, which are engaged chiefly in the transportation of coal, and of which the annual traffic ranges from 400,000 to more than 1,000,000 of tons—although it is scarcely to be doubted that the Baltimore and Ohio road is destined, hereafter, to accommodate a considerable coal trade also on the western portion of its route.

At this time the Baltimore road is in use only to the eastern base of the Alleghany mountains; is cut off by that barrier from the trade of the Ohio river and all its future connexions west of that river; and yet upon the fragment of the road that is completed, it conveyed, in 1849, no less than 165,300 persons, and 351,655 tons of freight.*

And, finally, as a further fact bearing on this question, I will add, that the mere *increase* of tonnage for one year on this unfinished road—the excess of 1849 over that of 1848—exceeded 80,000 tons.

With such facts to guide our judgment, and with no unreasonable law to control our estimates, with what propriety can we assume a traffic of 60,000 tons and 150,000 passengers, for the amount of trade and travel which will pass over this great road when completed to the Ohio river? There is no propriety in adopting such a course without the compulsion of legal obligation; but there is a manifest impropriety in making a false and unreasonable assumption of facts to govern the location of a great work which is intended and destined, for ages to come, to exercise an influence upon the commercial prosperity of the country.

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* I am not able to state the equivalent amount of through tonnage. There appears to me to be a misprint in the report of 1849, where this item is given.

This is no indifferent question. The amounts of trade and travel to be accommodated, are the overruling data which control almost every plan and computation incident to the location of a line of rail-road: and where two rival routes present themselves as candidates for adoption, their merits are tried by this test.

If we assume 60,000 tons for the actual trade, when that quantity is less than the value of one year's increase of trade—and estimate the cost of transporting 60,000 tons over the eleven miles of unnecessary space, when 300,000 tons may be the amount that will really pass, we underrate the expense of transportation through that addition to the road in the proportion of 60,000 to 300,000—or, we reduce it to *one-fifth* of its actual value;—precisely as we have already seen that, by estimating one train a day as sufficient to do the transportation of 60,000 tons a year, when the experience of the Company has shown that nearly four trains, loaded and unloaded, are needed for the duty, the cost of sending the 60,000 tons through the extra eleven miles was reduced *three-fourths*, and the cost of assistant power for aiding the same tonnage over the steeper grades of the Grave creek line was proportionally increased. Finally, by reducing the actual tonnage to one-fifth of its value, and increasing the loads of the engines to four times the average in practice, we may reduce the estimated value of the eleven unnecessary miles to *one-twentieth* of its real amount.

It is to be distinctly understood, that the amount of trade and travel are the facts which lie at the foundation of all these comparative estimates, and that the results must depend on the numbers here assumed.

But it is not my intention, in the present instance, to rest an estimate of the comparative merits of these routes, upon the vast traffic which I believe that the Baltimore and Ohio Company will be called on to pass over their road, in a very brief period after its completion to the Ohio—for my views on that subject might, in the judgment of very cautious persons, seem somewhat extravagant.

I will not even approximate to the quantities which may be inferred from the language of the President and Board. But I will assume a trade far below that of many roads in this country, which have not the resources of the Ohio river and the great West to draw on—a trade so low that the most cautious mind must admit its moderation.

The following estimate of the cost of maintaining and working the two lines under consideration, is made on the assumption of an annual traffic of 250,000 tons and 250,000 passengers.

I shall still apply the latest experience of the Baltimore and Ohio Company, though it is proper to add that a wider range of inquiry, embracing the experience of other works, applicable to this case, would produce a still larger balance in favour of the shorter line.*

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* The mere annual cost of maintaining 11 miles of the double track of the Boston and Lowell road, capitalized, will produce a sum much greater than the excess of the cost of constructing, maintaining and working the Grave creek over that of the Fish creek line, by the Chief Engineer's estimate.

COST OF MAINTAINING AND WORKING THE FISH CREEK LINE—$52\frac{27}{100}$ MILES.

Assumed traffic 250,000 *tons and* 250,000 *passengers per annum.*

MOTIVE POWER.		
250,000 passengers carried $52\frac{27}{100}$ miles, at	.350	$45,735
250,000 tons ,, ,,	.493	64,428
CAR EXPENSES.		
250,000 passengers ,, ,,	.251	32,798
250,000 tons ,, ,,	.321	41,947
ROAD EXPENSES (exclusive of track and bridges).		
250,000 passengers ,, ,,	.038	4,966
250,000 tons ,, ,,	.060	7,840
GENERAL EXPENSES.		
250,000 passengers ,, ,,	.084	10,977
250,000 tons ,, ,,	.161	21,039
To which must yet be added the ordinary repairs of $52\frac{27}{100}$ miles of single track, at $982, - - -		51,329
The maintenance of $52\frac{27}{100}$ miles of second track, at $500,		26,135
The wear and tear of $52\frac{27}{100}$ miles of track consequent on the passage of 250,000 tons of freight, at $\frac{25}{100}$ of a cent per ton per mile, - - - -		32,669
The wear and tear of $52\frac{27}{100}$ miles of track consequent on the passage of 250,000 persons, estimating 2 passengers and baggage as equivalent in wear and tear to one ton of freight, - - - -		16,334
Interest on cost of a depôt and general station at the mouth of Fish creek, when the trade is increased to the amount here assumed,* - - -		6,000
Cost of maintaining bridges (engineer's estimate), -		3,427
Total for maintaining and working the Fish creek line, -		$365,624

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* This item is not embraced in the engineer's estimate for construction.

COST OF MAINTAINING AND WORKING THE GRAVE CREEK LINE—$41\frac{305}{1000}$ MILES.

Assumed traffic 250,000 *tons and* 250,000 *passengers per annum.*

Motive Power.		
250,000 passengers carried $41\frac{305}{1000}$ miles, at	.350	$36,142
250,000 tons " "	.493	50,908
Car Expenses.		
250,000 passengers " "	.251	25,919
250,000 tons " "	.321	33,147
Road Expenses (exclusive of track and bridges).		
250,000 passengers " "	.038	3,924
250,000 tons " "	.060	6,196
General Expenses.		
250,000 passengers " "	.084	8,674
250,000 tons " "	.161	16,625
To which must be added, the ordinary repairs of $41\frac{305}{1000}$ miles of single track, at $982, - - -		40,561
The maintenance of $41\frac{305}{1000}$ miles of second track, at $500,		20,652
The wear and tear of $41\frac{305}{1000}$ miles of track consequent on the passage of 250,000 tons of freight, at $\frac{25}{100}$ of a cent per ton per mile, - - - -		25,816
The wear and tear of $41\frac{305}{1000}$ miles of track consequent on the passage of 250,000 persons, estimating 2 passengers and their baggage as equivalent in wear and tear to one ton of freight, - - - -		12,908
Repairs of bridges for this route (engineer's estimate), -		8,271
Total cost of maintaining and working the Grave creek route, exclusive of assistant power, - -		$289,743

Assistant Power.

I have already had occasion to state that the average load of merchandise in the freight trains of the Baltimore and Ohio road, in 1848, was 39 tons, and the average number of persons in the passenger trains was 61 in 1848, and but 50 in 1849. Such trains as these, and, indeed, trains almost twice as great as these, can be taken over grades higher than any on the Grave creek route, by the best class of freight and passenger engines on the Baltimore road. Assistant power will therefore be rarely needed.

But, I shall estimate this item liberally, and assume that the whole distance of 14 miles on the Grave creek route, where, and where only, the grades are steeper than those of the Fish creek line, are run over three times in each direction daily by heavy trains—making six daily trains that will require aid. By this assumption the assistant engine will run 84 miles daily. The average cost of running freight engines on the Baltimore and Ohio road, in 1848, was 19 cents per mile run.

We have then for the annual value of assistant power, with the amount of trade assumed in this estimate, 84 miles daily, at 19 cents, for 312 days,	$4,980
Add this sum, above obtained,	289,743
Total cost of maintaining and working the Grave creek line,	$294,723

We have now to capitalize the cost of maintaining and working these two lines, and add the results to the respective costs of construction, in compliance with our understanding of the intentions of the law.

FISH CREEK LINE.

Cost of construction, by estimate of Chief Engineer,	$1,971,638	
Annual cost of maintaining and working this line, $365,624—equivalent capital,	6,093,733	
Capital equivalent to the cost of constructing, maintaining and working this line,		$8,065,371

GRAVE CREEK LINE.

Cost of construction, by estimate of Chief Engineer,	$2,290,873	
Annual cost of maintaining and working this line, $294,723—equivalent capital,	4,912,050	
Capital equivalent to the cost of constructing, maintaining and working this line,		7,202,923
Difference in favour of the Grave creek route,		$862,448

It will be observed, however, that this result is still deduced in the assumption that *time* is of no value. Yet to put the lines on a footing of equality, they must be traversed in the same number of hours, a condition which requires the maintenance of a much higher rate of speed on the Fish creek route, which is 11 miles the longer. This speed cannot be obtained but by an equivalent outlay for repairs and running expenses, and this outlay is yet to be estimated, and capitalized, and added to the sum produced above.

Instead of making such an estimate, however, of the effect of this increased velocity, I shall merely estimate the value of the time lost on the longer route, and consider the running speed the same on both lines.

REMARKS ON THIS RESULT.

Your attention cannot fail to be attracted to the very important fact which these estimates disclose—viz: that the larger the trade and travel on the road, the greater will be the superiority of the Grave creek or shorter line. When the computations were made for a trade of only 60,000 tons and 150,000 passengers, this superiority was represented by a capital of $309,560; but when the assumed business of the line is increased so as to approach more nearly to the probable trade which will be upon the work when it is completed to Wheeling, this superiority is found to be represented by a capital of $862,000.

And it may be added, generally, that in the future history of the Company, the more successful their enterprise, the larger the trade and the greater the travel, the more important it will be to relieve that trade and travel of the cost of carriage over the unnecessary length of line. When this business approaches that of the most prominent railways of the present day, as it most assuredly will, and that in a very brief period, the maintenance and working of eleven miles of unnecessary and useless road will become a most serious burthen upon the prosperity of the Company, and perhaps a serious test also of the patience and forbearance of the community. The right of the Company to make this extraordinary circuit, in face of the Act to which they owe their creation—their right to tax the time and comfort of every citizen of the state to this extent—may possibly, even then, be questioned.

Every half hour or oftener, a train of cars will soon be despatched over this road in each direction; and if the location now proposed be adopted, each engine, with all its passengers, cars and merchandise, must be run eleven miles out of the way, at a sacrifice to the public equal to the cost of the unnecessary carriage, the loss of more than half an hour every trip, and the fatigue and vexation consequent on the imposition.

And here it is appropriate to call your attention to some suggestions on this head which appear in the concluding paragraphs of the final report of the Chief Engineer, on the comparative merits of these routes.

The importance of saving time and distance is, in those passages, fully admitted, as well as the dependence of the amount which may be paid for such economy of space and time, upon the amount of trade. I refer to the following—

"It will be practicable, however, at some distant day, "when the trade and revenue of the line will be so "large and profitable, and the saving of time in the "transit and wear and tear of the road and machinery "so important, to shorten the distance in the Fish "creek valley some six miles, by cutting off the bends "at Gorby's and Kirby's above the forks of the creek, "and at Garland's, Janney's, Kelly's and Arnolds' "farms below the forks. The first five of these bends "would require as many tunnels, of an aggregate "length of one mile, by which and three additional "bridges at the other points, a total saving of about "the above number of miles would be made without "any drawbrack for increase of curvature or ascent: "such a location, however, could not be, *just now*, re-"commended, as it would involve an increase of cost "incommensurate to the advantages to be gained, in "the best state of the trade likely to exist for some "time after the completion of the road."

We learn from this passage, that at the particular time when these estimates were made, the Chief Engineer of the Company had considerable doubts of the rapid and immediate success of the Baltimore and Ohio road, when it shall have reached the Ohio river—that point where, in the language of the President, delivered a few months later, "it is conceded by the "most skeptical, that the revenue of the road cannot "be interfered with—where its destiny will be forever "established—and where the only question that is "likely to arise, will be as to the ability of the Com-"pany to supply the power to accommodate the trade." It would strike the reader with surprise to find that the only person who had ever been skeptical of these undoubted conclusions, was the Chief Engineer of the Company, from whose own subsequent calculations the conclusions were drawn. In giving to the public the estimate which the Chief Engineer has made of the increase of revenue when the work shall reach to the Ohio river, the Directors do not say that this $2,700,000 is to be added to their income "at some distant day," or invite the confidence of capitalists on any such remote contingency. The doubts which prevailed in February, when the comparative estimates were made, had, obviously, been entirely dissipated in November, when the Company and their officers were fully impressed with the importance of their great work, and the vast trade awaiting its completion.

But there are much more important views to be taken of this remarkable passage; for it appears from this language, that while the Act of Assembly is looking to a permanent improvement, and requiring the cost of maintenance and working to be capitalized in framing the estimates—as though the arrangements were to be everlasting—the location has been made with a view to a temporary structure, a portion of which is to be abandoned so soon as the revenue becomes more considerable. At least seven miles (but more probably ten) of this double track road in the valley of Fish creek, is to be thrown aside after it is built, for the purpose of saving six miles of distance; and for the same object five tunnels, three bridges, and some miles of new road are also to be constructed.

It is impossible, from the facts stated in the report of the Chief Engineer, to determine the value of the six miles of distance which is to justify this procedure, so as to apply the same scale to the *eleven miles* that will be saved by taking the Grave creek route. It is, however, very clear that the change proposed will involve a sacrifice of probably $300,000 worth of property on the abandoned line, and a further expenditure of some $600,000 on the tunnels and cross cut made for the purpose of effecting this reduction of distance.

It is important that you should have a full statement of all the facts touching this change of route, so that you may know what the ultimate capital invested in that line is to become, and what is the amount of trade on which the calculations indicating the propriety of the future change of location are based. In the papers submitted to me by the Committee, there are no comparisons presented excepting for the temporary line, which I have discussed in this report.

It has already been shown that the Grave creek route is cheaper than that temporary expedient to construct, maintain and work, under such a trade as I believe may be immediately anticipated, by the sum of $862,000. But this sum has been deduced in the assumption that the same *speed* is to be maintained on both routes, and that *time* has no value. We have therefore yet to add to the result, the cost of making the trips on the longer line as quick as they are made on the shorter one; or, which amounts to the same thing in principle, and in effect, though differing in mode, we must, if we continue to assume the same speed on both routes, estimate fairly the value of the time that is lost on the longer one.

OF THE EFFECT OF SPEED OR THE VALUE OF TIME.

Your attention is now directed to another very important branch of this subject which cannot be overlooked in the selection of routes differing in length; and which, in my opinion, we are compelled fairly to examine if we attempt to adhere to the principles of a report which professes to be aiming to discover "the shortest and best line." If, under a proper construction of the Act of March 6, 1847, it be the duty of the engineer to ascertain THE BEST LINE, in view of all the facts which affect that comprehensive problem, there is yet another element to be considered which has not entered into any of the recent comparative estimates. That element is THE VALUE OF TIME.

That this element is of importance in the selection of a route is admitted in the report of July 12, 1845, though like all the "principles" contained in that report, it is very vaguely thrown out. "Distance "and time cannot be annihilated by competition, though "they may for a time be disregarded in the heat of it; "and"—adds the report—"the *people of Wheeling ad-* "*mit this in saying they will be ruined by a termina-* "*tion of the road below them.*" (Report of July 12, 1845, page 18.)

We have here a direct admission that the value of time cannot be entirely overlooked, and that, if it is overlooked, the city of Wheeling—whose interests and vested rights the State of Virginia has deemed it proper, and for the public good, to protect from this threatened injury—may be ruined.

But it is not only in that report which the law prescribes as the source whence the plans and principles of the comparative estimates are to be drawn, that we find this admission, but on the last page of the report in which the final results of the surveys required by the Act, are announced, it is again brought forward. The idea is there presented that the trade will yet be so large on the Baltimore and Ohio road, "and the saving of time in the transit, and wear and tear of the road and machinery so important," that the abandonment of many miles of the temporary road which it is proposed to construct on Fish creek may become advisable, and the substitution of a shorter line, having five tunnels and three bridges, &c. be recommended.

Although I cannot approve, in this case, of the construction of a line obviously improper, first, with a view to throw it away afterward and make a better one for the purpose of saving time, and wear and tear of machinery, I yet approve fully of the principle which recommends giving due value both to the considerations of time, and wear and tear. This is in accordance with the language of the Report of July 12, 1845, adopted by the law. The word "shortest" is introduced into that report in a form which shows that it means *something.* If it mean any thing, it must mean that there is an advantage in having a short line, apart from the mere cost of construction and working at a given speed; and that the full value of that advantage, whatever it may be, should be introduced into the calculations instituted for the purpose of determining which is positively "*the best route.*"

It is repugnant to every rational view of public policy to suppose that it could have been the intention to require, by express statute, the adoption of a line which was not really the best; or to offer encouragement for the selection of an imperfect route—by leaving out of view some of the most important elements which could enter into the comparative estimates.

In discussing this subject we are to recollect that there is, and is likely always to be, a brisk competition among the various rail-road lines seeking the trade and travel of the Ohio river and of the country west of that stream; and that in adopting the Fish creek line, the Company tax every passenger with the value of his time while they are transporting him and his goods over these 11 miles of road: that, on the other hand, each passenger looks at the rival claims of the several routes, ascertains their charges, the amount of his time which they will respectively absorb in conveying him to his place of destination, and calculates the fatigue and discomforts to which he will be subjected while in their safe keeping.

If he knows that one of these companies, after conveying him from Baltimore to Wheeling through their legitimate route, before they will allow him to leave their cars, will insist on giving him a further ride of 11 miles—carrying him, as on the Fish creek route, twice around a full circle 5½ miles in circumference—and exposing him to the fatigue and loss of time which that ride involves, he will certainly put his own value upon that time and that annoyance. The expense to the Company, whether it consist in the loss of passengers and goods consequent upon this tax, in the premium which they must offer to induce people to subject themselves to the inconvenience, or in the greater diligence and speed, which they must adopt on this or other parts of their road, to compensate for this imposition upon their customers, is still *a charge* upon their finances, and a part of the real cost of maintaining and working their road. To place the two lines on an equality in point of time, a greater speed must be kept up around the curves of the Fish creek line than upon the shorter and more direct route by Grave creek. If the lines are traversed *in the same time*, the cost of freight ton by ton and mile by mile will be much the least on the latter route. And if we do not consider, in computing the actual expenses of working the lines, that the trips are made in equal time, we must allow for that neglect in some other form.

We have made no such allowance in the preceding estimates, but have assumed that the same speed is to be adopted on both lines. Instead of deducting from the expenses of working the shorter line, or adding to those of the longer, to compensate for the difference of speed required, I shall make the allowance in the shape of an estimate of the value of the time lost, supposing the velocity to be the same on both routes. The preceding estimates are based on the supposition that the velocity is to be the same as that to which experience has limited the Company on their finished work; and as they have found it better economy to restrict the velocity of their trains, than to seek a further saving of time by a further sacrifice of machinery and wear and tear of road, it will be better here also to allow for the time lost on the longer route, than to assume that the more expensive course is adopted, and the velocity increased.

I estimate this item at 10 cents for the half hour* that will be lost by each passenger, or spent by each passenger in discomfort, while traversing the 11 unnecessary miles of the Fish creek line. But 10 cents for each of 150,000 persons, is $15,000 per annum—a sum which is represented by a capital of $250,000. I waive the value of time upon the 60,000 tons of goods, which is of very uncertain amount, and also that upon the machinery used in traversing the unnecessary space. The object in this division of the subject is not to obtain, or pretend to obtain, precise results by a computation necessarily founded on data in a great degree conjectural; but rather to adopt quantities and assumptions so clearly safe and moderate, that the results may be taken as probably fair though uncertain approximations. I am convinced, however, that this allowance is less, by nearly one half, than must be made, if the velocity be increased on the longer line so that the trips on both routes may be made in equal times.

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* The difference in time, including the necessary delay at the extra station, will probably be 40 minntes.

Pursuing the same course under the assumption of a travel amounting to 250,000 persons annually, and neglecting still the value of the goods, we shall obtain for the value of time, at the rate of 10 cents for the half hour or more saved by each passenger in taking the shorter route by Grave creek, the sum of $25,000 per annum—an amount which is represented by a capital of $416,000.

The value of time increases with the number of passengers and the amount of goods conveyed; and if the Fish creek line were adopted in the outset, and the Baltimore and Ohio road should attain that degree of prosperity which its Directors and advocates hope to witness, and of which I have myself no doubt—unless they trifle elsewhere with their natural advantages as is proposed in this location—the error of original construction will ultimately be repaired—though not by cutting off the bends in the valley of Fish creek, so as to save six miles of distance, but by taking the Grave creek route at last, and saving eleven.

The conclusions at which I have arrived in this examination, may be briefly recapitulated, as follows:—

I. If the true construction of the law of March 6, 1847, require that the comparative estimates shall be made for just 60,000 tons of freight and 150,000 passengers, per annum, and that the value of the time saved by the shorter route, or the cost of the higher speed required on the longer route, shall not be admitted as one of the elements of the comparison, then the Grave creek route by Hart's run will be cheaper than the route which the Chief Engineer of the Company has recommended as a temporary location, by way of Fish creek, to construct, maintain and work, by the sum of - - - - - - - $309,000

II. But if the same trade and travel be adopted, and the cost of maintaining speed, or the value of time be recognised as a proper element to be used in determining "the shortest and best line," with that amount of trade and travel, then the Grave creek route will be the cheaper of the two to construct, maintain and work, by the sum of about - - - - - - $559,000

III. But, if the engineer is not compelled to assume precisely the amount of trade and travel which was assumed by the Chief Engineer of the Company in his report of July 12, 1845, but is to regard that amount as a *minimum* set by the law, and is to take those amounts of trade and travel which he thinks may be reasonably expected on the completion of the road—which trade and travel I believe cannot be less than 250,000 tons and 250,000 passengers per annum—but is required to exclude the cost of speed and value of time from the problem, then the Grave creek route will be the cheapest to construct, maintain and work, by the sum of - - - $862,000

IV. But, finally, if the question be thrown completely open, so that he may, under the law, exercise his best judgment as a practical engineer, and assume that amount of trade and travel (not less than the legal limits), which he finds authority to conclude will probably pass over the road, in a reasonable time after its completion to the Ohio, and may also include the cost of speed or value of time as an admissible and necessary element, in deciding on the "best route," I find that the road by the way of Grave creek will be the cheaper to construct, maintain and work, by about $1,278,000

If it were the intention of the law, in adopting the "principles" of a report which sets forward the problem of "the shortest and best line" as the great object of its researches, without describing the mode of pursuit to attain it, to prescribe that the future comparative estimates shall also look to obtaining the best route, and consider the value of "shortness" in the examination, then the last and largest of the four results which have been deduced, is the nearest approximation to the value of the superiority which the Grave creek route by Hart's run possesses over the line which the Company propose to adopt. *This superiority is represented by one and a quarter million of dollars;* while, in selecting the line which fully satisfies the most stringent reading of the law, and yet possesses this further advantage, the Company, and the public, for whose benefit the Company is permitted to exist, will have the satisfaction of knowing that the sum which represents the measure of the superiority of the shorter route, will increase from year to year *pari passu* with the advances which the road itself may make in prosperity and value.

RECAPITULATION.

I will now present to you the several leading grounds of the objections which, in my opinion, you have a right to make to the choice of the Fish creek route, which the Company have evinced a determination to adopt.

I. They have not yet made "minute estimates, after full examinations and instrumental surveys, of all the feasible or practicable routes," as is expressly required by the Act of March 6, 1847. The Wheeling creek route, undoubtedly practicable, and possibly the "shortest and best," has not been examined.

II. The computations intended to show the cost of constructing, maintaining and working the Fish creek route—the one proposed to be adopted—are not made for the precise line which it appears to be the intention ultimately to use; but the estimates for that route are based upon a temporary line which, it is intimated, may be advantageously abandoned after the trade and travel shall have been well developed.

III. The estimate for constructing depôt buildings, stations and work-shops—especially at the mouth of Fish creek—applies only to temporary erections, and not to the permanent and extensive structures that will be needed to accommodate the amount of trade and travel contemplated by the law.

IV. The estimates have not been controlled by the principles of the report which the Act prescribes for the guide; and in default of sufficient indications in that report, instead of proceeding upon the results of experience, the estimates are based upon the theories of a certain other report unknown to the law: and in estimating the merits of the two routes upon the authority of this other report, *its* principles are disregarded or misapplied, in points of vital consequence, to the serious prejudice of your rights and the truth.

V. The estimates are based on suppositions which have no analogy in practice. They assume an equal daily amount of trade and travel in each direction, to be accommodated by trains from three to four times as large as can be expected, in the future practical operations of the road, or, as have yet been obtained in the past experience of the Company.

These erroneous suppositions lessen the value of the increase of distance on the line which threatens your prosperity, and increase the apparent importance of the steeper grades on the one which protects your interests.

VI. The estimates take no account of the effect of the increase of distance to be traversed in a given time, on the velocity of the trains, or on their loads, or on the running expenses. They assume that time is of no value, and proceed upon the supposition that it costs as much to run at a slow rate, on the shorter line, as at a rapid speed on the longer one. These assumptions are not stated in words, but are developed in the calculations.

VII. The estimates assume that a double track road may be kept in permanent repair for less than one-half the sum which the experience of the Company has established, thereby diminishing more than one-half the cost of maintaining the eleven unnecessary miles encountered in avoiding the direct route to your city.

VIII. The estimates take no account of any of the miscellaneous, or general rail-road expenses due to the extra eleven miles; a neglect which operates unfairly by reducing, to that extent, the capitalized cost of maintaining the longer route.

IX. Finally, these estimates assume as the basis of the whole comparison, an amount of trade much less than the Company anticipate on the completion of their road to the Ohio river, and far less also than can reasonably be looked for when it reaches there. The estimates assume a *total trade*, on the completion of the road, *less than one year's increase* of that now carried on the finished fragment.

Each and all of these oversights and erroneous assumptions operate to the prejudice of the shorter line, and that to such an extent as to produce a total difference of more than a million and half of dollars in the final result.

I cannot doubt, with my personal knowledge and high estimation of the able engineer who conducted the surveys and prepared the report, that these errors have been produced in part by a misconception of the intentions of the law, and in part by overlooking the facts, or the full bearing of the unfair assumptions upon the momentous question at issue.

Looking at the successive acts of legislation by the State of Virginia, and especially at the contract based on the Act of March 6, 1847, by which your city is promised "the practical benefits of the western terminus of the Baltimore and Ohio Rail-road, according "to the provisions of that Act,"—an Act which requires that the location shall be made on that route, within certain limits, which is "the cheapest to construct, maintain and work," and which contemplates that it be also "the best," and if possible, compatibly with other provisions, "the shortest"—I cannot believe that, in the face of such enactments, the Company will be permitted to adopt a line which is eleven miles longer than the shortest and best; which, instead of being the cheapest in the contemplation of the law, is more than a million and a quarter of dollars dearer than its competitor; and which, instead of securing to your city "the practical benefits of the western terminus of the road," will inevitably build up another city, rival to your prosperity, twenty-three miles below you.

Such a location is, in my opinion, opposed by the intentions of the law and the contract, and it is certainly repugnant to every consideration of justice.

Your obedient servant,

CHARLES ELLET, Jr.
Civil Engineer.